Date of Issue:
Revision Issue Date: September 25, 1986

Y-DZ-12/Rev. 1

1981 ANALYSIS OF S-3 PONDS

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*Work performed prior to April 1, 1984, by Union Carbide Corporation Nuclear Division for the U. S. Department of Energy under Contract W-7405-eng-26.

Prepared by the
Oak Ridge Y-12 Plant
P. O. Box Y, Oak Ridge, Tennessee 37831
operated by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
under Contract No. DE-AC05-84OR21400

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ABSTRACT

This report reviews the current status of the four S-3 acid ponds in the Oak Ridge Y-12 Plant and compares the results of this review with past pond analyses. Data on the effect of neutralization are also presented. Based on stricter Environmental Protection Agency regulations, several alternatives for treating the ponds are given. This report includes all data collected in 1981 on the contamination level of the S-3 ponds.

SUMMARY

The four S-3 acid ponds at the Oak Ridge Y-12 Plant are currently used to dispose of nitric acid, other acids, wastewaters, coolants, and biodenitrification sludge. Data were collected in 1981 and compared with the results of analyses of the ponds made in different tests during 1961, 1975, and 1978. This comparison indicates that the contaminant levels in the ponds have dropped measurably, with the most notable change being the nitrate concentration.

Since Environmental Protection Agency (EPA) regulations have forced the phasing out of the ponds, two methods of treatment were found to be effective in neutralizing the ponds sufficiently to allow them to be drained into Poplar Creek.

INTRODUCTION

Approximately 1.5 million gal/year of liquid wastes is being pumped into the east-side ponds of the four S-3 ponds. The southeast pond is primarily used as a dump for contaminated wastewaters, dilute acids, coolants, caustic solutions, and biodenitrification sludges. The northeast pond contains mainly nitric acid, other concentrated acids, aerosol cans, and small propane containers. Wastes are introduced to the ponds by surface dumping or by a series of underground pipes. The eastern ponds are connected to the western ponds by overflow pipes. The ponds are unlined, and it is believed that the southwest pond leaches much faster than the other ponds, because it contains significantly less liquid than the other ponds.

Stricter EPA regulations have forced the discontinuation of use of the S-3 ponds in the near future. The Central Pollution Control Facility (expected to be constructed in 1982) will handle the inorganic waste streams now dumped into the S-3 ponds. When the ponds are no longer in use, the liquid remaining in them must be treated sufficiently to drain into Poplar Creek. The remaining solids will probably be buried. However, suitable alternatives could include fixing with cement, covering in place, or putting the solids into temporary storage.

PRESENTATION OF EXPERIMENTAL WORK

A total of three samples were taken from the top of each pond on Oct. 7, 1981. A bottom sample was taken Oct. 14, 1981, and a final top sample was taken Oct. 22, 1981. Each sample was analyzed as taken from the pond. The data from these analyses, as compared with similar tests performed in 1975 and 1978, are presented in Tables 1–4. Note that there has been a general decrease in all contaminants in each of the ponds except the southeast pond. The higher contaminant levels in the southeast pond can be explained by the difference in hydrogen ion activity in the pond—a pH of 4.7 in 1978 as compared with a pH of 1.8 in 1981. The higher pH would precipitate more contaminants from solution, causing the lower contaminant concentrations of 1978.

Table 1. Summary of average contamination in the southeast acid pond at the Y-12 Plant

Contaminant species	Annual contaminant concentration[a] (μg/g)		
	September 1975	September 1978	November 1981
F^-	0.02	5	8
NO_3^-	20,700	9,000	36,000
U	46	20.8	105
Al^{3+}	1,600	154	2,809
B^{3+}		2.1	5.49
Ba^{2+}		0.6	1.12
Ca^{2+}	210	2,251	4,741
Cd^{2+}		0.5	0.760
Co^{2+}		0.3	0.145
Cr^{3+}		4.2	14.4
Cu^{2+}		2.1	15.1
Fe^{3+}		1.3	142
K^{1+}		95	56.0
Li^{1+}		6	13.9
Mg^{2+}	190	157	480
Mn^{2+}		10	4.59
Na^{1+}		658	579
Ni^{2+}		27	49.5
Sr^{2+}		1.1	3.72
Th^{4+}	34	0.1	2.69
Zn^{2+}		1.6	14.0

[a]pH levels were 0.8 in September 1975, 4.7 in September 1978, and 1.8 in November 1981.

Table 2. Summary of average contamination in the northeast acid pond at the Y-12 Plant

Contaminant species	Annual contaminant concentration[a] (μg/g) September 1975	September 1978	November 1981
F^-		12	12
NO_3^-		45,800	4,400
U		227	536
Al^{3+}		2,261	1,313
B^{3+}		23	20.6
Ba^{2+}		0.6	0.117
Ca^{2+}		438	429
Cd^{2+}		79	0.415
Co^{2+}		0.8	0.501
Cr^{3+}		48	15.6
Cu^{2+}		28	20.2
Fe^{3+}		467	683
K^{1+}		195	62.5
Li^{1+}		22	6.76
Mg^{2+}		411	193
Mn^{2+}		16	9.27
Na^{1+}		2,887	1,382
Ni^{2+}		91	109
Sr^{2+}		2.4	1.10
Th^{4+}		53	19.4
Zn^{2+}		5	8.59

[a]pH levels were 1.0 in September 1978, 1 8 in November 1981.

Table 3. Summary of average contamination in the southwest acid pond at the Y-12 Plant

Contaminant species	Annual contaminant concentration[a] ($\mu g/g$)		
	September 1975	September 1978	November 1981
F^-		4.5	
NO_3^-	32,600	15,700	15,000
U	141	95	95
Al^{3+}	1,575	1,019	1,062
B^{3+}		7.8	8.41
Ba^{2+}		0.5	0.255
Ca^{2+}	210	199	608
Cd^{2+}		1.2	0.426
Co^{2+}		0.4	0.369
Cr^{3+}		11.8	9.78
Cu^{2+}		8.2	9.60
Fe^{3+}		217	136
K^{1+}		76	67.9
Li^{1-}		6	5.33
Mg^{2+}	190	149	150
Mn^{2+}		8.1	13.4
Na^{1+}		1,248	967
Ni^{2+}		27	39.1
Sr^{2+}		0.9	1.02
Th^{4+}	37	20	15.8
Zn^{2+}		1.9	6.29

[a]pH levels were 0.8 in September 1975, 1.3 in September 1978, and 1.5 in November 1981.

Table 4. Summary of average contamination in the southwest acid pond at the Y-12 Plant

Contaminant species	Annual contaminant concentration[a] (μg/g)		
	September 1975	September 1978	November 1981
F^-	80	19	14
NO_3^-	82,200	45,300	14,000
U	608	246	99.2
Al^{3+}	6,300	3,102	2,390
B^{3+}		14	13.8
Ba^{2+}		2.5	0.796
Ca^{2+}	800	588	473
Cd^{2+}		3.1	1.01
Co^{2+}		0.9	0.566
Cr^{3+}		38	19.6
Cu^{2+}		22	18.3
Fe^{3+}		691	428
K^{1+}		251	134
Li^{1+}		14	9.89
Mg^{2+}	700	435	290
Mn^{2+}		16	12.8
Na^{1+}		1,872	1,298
Ni^{2+}		49	77.8
Sr^{2+}		3	1.90
Th^{4+}	147	72	46.3
Zn^{2+}		7	7.28

[a]pH levels were 0.3 in September 1975, 0.95 in September 1978, and 1.2 in November 1981.

Nitrates are a special concern when considering environmental release from these ponds. The summary of nitrate reduction (Table 5) illustrates that nitrates have decreased a total of 74% since 1961 and are approaching typical disposal limits. Total quantities of remaining contaminants in each pond are given in the Appendix, Tables A.1–A.4.

Table 5. Summary of significant data extending from 1961 on the four S-3 acid ponds in the Y-12 Plant

Data	Year			
	1961/1962	1975	1979	1981
pH				
Southeast	0.1	0.8	4.7	1.8
Northeast	0.1		1.0	1.8
Southwest	0.1	0.8	1.3	1.5
Northwest	0.1	0.3	0.95	1.2
NO_3^-, µg/g				
Southeast	57,273	9,409	4,091	16,364
Northeast	45,591	37,364 (est)	20,818	2,000
Southwest	15,000	14,818	7,136	6,818
Northwest	11,364	37,364	20,591	6,364
Total NO_3^-, kg				
Southeast	954,091	155,909	67,727	273,111
Northeast	759,545	622,727 (est)	346,818	33,380
Southwest	312,273	308,636	148,636	142,245
Northwest	236,818	778,181	428,636	132,762
Total NO_3^- pond, kg				
	2,262,727	1,865,909	992,727	581,364
NO_3^- change, % (from 1961)		−17.4	−56.1	−74.3

Each sample was neutralized with calcium oxide (CaO). The qualitative observations of this test and of the ponds are given in Table A.5. The quantitative data (given in Table A.6) indicate that no more than 1.2 g CaO/100 mL of sample are required to bring the pH to an 8.0 to 8.5 range. The results of the analyses of the neutralized liquids are given in Table A.7. All contaminant concentrations were greatly reduced after neutralization with the exception of calcium and strontium. Because strontium is a common impurity in CaO, these results are not unusual.

Several titration curves were obtained by titrating the pond samples with 1.0 *N* NaOH. The titration curves of Figs. A.1–A.4 in the Appendix show the slight precipitation of iron at a pH of 2.0 (except in the southeast pond) and the larger precipitation of aluminum at a pH of 4.0. These curves also explain the difficulty of neutralization by the length of the precipitation-buffer zone. The titration curves of the bottom samples (Figs. A.5–A.8) show that the bottom of the ponds is somewhat higher in contamination levels and, thus, is more difficult to neutralize. The difficulty in neutralization would not arise from use of NaOH rather than CaO because NaOH is just as effective and more efficient (being in solution) than CaO, which has to be dissolved. Data for all titration curves appear in the Appendix Tables A.8–A.11.

Biodenitrification sludge was also tested as a neutralization medium. The data from this experiment are shown in Table A.12 in the Appendix. Copious quantities (no less than a 2:1 ratio of sludge to sample) of sludge, with a pH of 7.6, were needed to bring the samples to a pH range of 6.6 to 7.3. Calcium oxide could be used to further raise the pH to ~8.0. However, because of the increased volume of sample with the added sludge, more CaO (2 to 3 g/sample) was required to raise the pH to ~8.0 than if only CaO was used for neutralization.

CONCLUSIONS

Several conclusions and recommendations were determined from this study. The first, and most important, conclusion is that the general condition of the ponds has greatly improved over the years. In particular, the biodenitrification facility has caused a 74% decrease in overall nitrate composition of the ponds. Second, neutralization reduces the contaminants in the liquids, through precipitation, to reasonable release limits dictated by the EPA.

Three neutralization mediums are feasible for the treatment of the ponds. After all inorganic wastes are diverted to the Central Pollution Control Facility, lime, limestone, or biodenitrification sludge could be used for neutralization. Lime would be the quickest, most efficient, and easiest to control; but there are a few problems. First, lime is more expensive than limestone or sludge. Second, introducing the lime to the ponds would be a minor problem because dust from the operation could become a health hazard. Limestone would be inexpensive and easy to introduce into the ponds, but neutralization time might be longer, depending on particle size and pH. The length of time required to dissolve powdered CaO indicates that the time required to dissolve limestone would be prohibitive for such a large-scale operation. Biodenitrification sludge is free. The sludge would only neutralize to a pH of about 6.9, however. Even though large quantities of sludge are needed to neutralize the ponds, sludge is an ongoing waste stream. The only possible drawback would be the added solids, which increase the total solids in the ponds during neutralization. This is not a major concern, however, because the volumes of the ponds far exceed any anticipated solids buildup problem.

RECOMMENDATIONS

The ponds themselves can be utilized for neutralization. One method would be to use the southwest pond, which is virtually empty for one-half of the jar, as the only "reactor." The liquid from the other ponds could be individually pumped into it and neutralized with sludge. After settling a few days, the effluent could be siphoned from the top of the pond to Poplar Creek. The advantage of this method would be the ability to control the specific neutralization requirements of each individual pond. The disadvantage would be that the operation would be batchwise and somewhat slow. A second method would involve the same treatment but could be carried out in both southern ponds. The process could be done on a fairly continuous basis: one pond could be draining while the other was being treated and settled. The only possible drawback would be anticipated problems with neutralization of the southeast pond, which could be given specialized attention if only the southwest pond were used. At this time, to avoid the expense of lime and the difficulties of using the southeast pond, it is recommended that biodenitrification sludge be used to neutralize the ponds by treating each pond individually in the southwest pond.

Appendix

DATA OBTAINED FROM THE S-3 ACID PONDS

Table A.1. Total amount (kg) of contaminant species in the southeast acid pond at the Y-12 Plant

(Basis: pond volume equals 8 x 10^6 L)

Contaminant species	Year 1975	1978	1981
F^-	1,125	32	60.5
NO_3^-	155,909	67,727	273,111
U^{6+}	347	75	796
Al^{3+}	11,091	1,155	21,310
Ca^{2+}	1,575	28,031	35,967
Cl^-	750	1,845	
Cr^{3+}		31	109
Cu^{2+}		16	115
Fe^{3+}		6.82	1,077
K^{1+}		713	425
Mg^{2+}	6,622	1,177	3,641
Na^{1+}		4,935	4,393
Ni^{2+}		202	375
Th^{4+}	259	91	20.4

Table A.2. Total amount (kg) of contaminant species in the northeast acid pond at the Y-12 Plant

(Basis: pond volume equals 8 x 10^6 L)

Contaminant species	Year		
	1975	1978	1981
F^-	7,095 (est)	128	91
NO_3^-	622,727 (est)	346,818	33,380
U^{6+}	5,752 (est)	1,710	407
Al^{3+}	59,598 (est)	21,465	9,961
Ca^{2+}	7,568 (est)	4,290	3,255
Mg^{2+}	6,622 (est)	3,082	1,464
Cr^{3+}		360	118
Cu^{2+}		210	153
Fe^{3+}		3,495	5,182
K^{1+}		1,462	474
C^{2+}	3,784	14,895	
Na^{1+}		21,652	10,485
Ni^{2+}		686	827
Th^{4+}	1,390 (est)	394	147

Table A.3. Total amount (kg) of contaminant species in the southwest acid pond at the Y-12 Plant

(Basis: pond volume equals 10 x 10^6 L)

Contaminant species	Year 1975	1978	1981
F^-	1,419	47	
NO_3^-	308,636	148,636	142,245
U^{6+}	1,325	908	901
Al^{3+}	14,900	9,640	10,071
Ca^{2+}	1,986	1,835	5,765
Cl^-	945	6,981	
Cr^{3+}		111	93
Cu^{2+}		76	91
Fe^{3+}		2,052	1,290
K^{1+}		719	644
Mg^{2+}	1,797	1,409	1,422
Na^{1+}		11,806	9,170
Ni^{2+}		246	371
Th^{4+}	346	194	150

Table A.4. Northwest pond—amount of chemicals (kg)

(Basis: pond volume equals 10 x 10^6 L)

Chemical	Year 1975	1978	1981
F^-	7,095	189	133
NO_3^-	778,182	428,636	132,762
U^{6+}	5,752	2,337	941
Al^{3+}	59,598	22,977	22,665
Ca^{2+}	7,568	5,279	4,485
Cr^{3+}		359	186
Cu^{2+}		208	174
Fe^{3+}		6,537	4,059
Mg^{2+}	6,622	4,115	2,750
K^{1+}		2,374	1,271
Cl^-		12,307	
Na^{1+}		17,718	12,309
Ni^{1+}		463	738
Th^{4+}	1,390	681	439

Table A.5. Sample and neutralization test observations of the four S-3 acid ponds at the Y-12 Plant

Southeast	This pond was, for all intents and purposes, full. The pond appeared muddy. The sample taken from the bottom appeared very muddy. Several 55-gal drums were observed in the pond. An oily film was on the pond when the final top sample was taken. This sample was very difficult to neutralize. The CaO was not inclined to dissolve, and a great deal of CaO did not, in fact, ever dissolve. A great deal of solids precipitated at a pH of 4.0, indicating a high aluminum content. The precipitate and remaining liquid were both very yellow. Test data indicate no major differences between the top and bottom of the pond.
Northeast	This pond was also full. The water was fairly clear, although an oily film was on this pond, too, when the final top sample was taken. Both top and bottom samples were clear. Quite a bit of "garbage" was in this pond. This sample was the easiest to neutralize. The CaO dissolved readily, and not much precipitate formed. The precipitate was formed at a pH of 2.0 and 4.0, indicating iron and aluminum. The precipitate was light yellow in color, and the liquid was colorless.
Southwest	The water level was about 30.48 cm (10 ft) below the level of the other ponds. The pond and samples were all clear, and no garbage was in the pond. This sample was easily neutralized. The amount of precipitate formed was somewhere between the amount formed from the southeast and the northeast ponds. The color was intermediate of the two, also. Precipitate formed at a pH of 2.0 and 4.0, also indicating iron and aluminum. The liquid was colorless. The pH of the top and bottom remained constant, but it took a great deal more CaO to neutralize the bottom, and more precipitate formed.
Northwest	This pond was full and extremely clear. The water had a bluish-green cast that none of the other ponds had. No garbage was in this pond. This sample was easy to neutralize. It produced the least amount of precipitate, and the precipitate was the lightest yellow. Precipitate formed at a pH of 2.0 and 4.0. The neutralized liquid had a bluish-green cast. The bottom sample from both the northeast and northwest ponds had a markedly lower pH than the top samples, and it took a great deal more CaO to neutralize both of the bottom samples. Both bottom samples produced more precipitate.

Table A.6. Data from the calcium oxide neutralization of the four S-3 acid ponds at the Y-12 Plant

Sample date type[a]	Pond[b]			
	Southeast	Northeast	Southwest	Northwest
October 7/Top	Initial pH 1.9 1.1 g CaO to pH 8.3	Initial pH 1.9 0.4 g CaO to pH 8.2	Initial pH 1.4 0.7 g CaO to pH 8.3	Initial pH 1.4 0.8 g CaO to pH 8.4
October 14/Bottom	Initial pH 1.5 1.2 g CaO to pH 8.3	Initial pH 1.5 2.7 g CaO to pH 8.3	Initial pH 1.4 2.9 g CaO to pH 8.5	Initial pH 0.9 2.8 g CaO to pH 8.3
October 22/Top	Initial pH 1.6 1.15 g CaO to pH 8.1	Initial pH 2.0 0.25 g CaO to pH 8.1	Initial pH 1.8 0.6 g CaO to pH 8.3	Initial pH 1.4 0.7 g CaO to pH 8.0

Table A.7. Percentage change in contaminant amounts present in samples after calcium oxide neutralization with final concentrations of four S-3 acid ponds at the Y-12 Plant

Contaminant	Southeast		Northeast		Southwest		Northwest	
	Change (%)	Final concentration (μg/g)	Change (%)	Final concentration (μg/g)	Change (%)	Final concentration (μg/g)	Change (%)	Final concentration (μg/g)
F								
NO_3	~0		~0		~0	~0		
U	-54		-91		-98			
Al	-100	0.14	-100	0.18	-100	~0	-100	0.31
B	-27	4.1	-20	9.4	-38	4.8	-23	11
Ba	+21	1.4	-53	0.06	-18	0.20	-36	0.21
Ca	+191	14,000	+450	1,800	538	4,000	+1236	4,300
Cd	-99	0.005	-100	~0	-100	~0	-100	~0
Co	-100	~0	-100	~0	-100	~0	-100	~0
Cr	-100	0.03	-100	~0	-100	~0	-100	0.03
Cu	-96	0.51	-100	0.02	-100	0.1	-100	0.06
Fe	-100	0.16	-100	0.03	-100	0.05	-100	0.11
K	+67	85	-13	23	-7	69	+16	86
Li	-86	2.2	-27	1.9	-44	3.3	-71	1.8
Mg	-29	330	-29	53	-36	97	-51	73
Mn	-97	0.15	-100	~0	-100	0.05	-97	0.25
Na	+21	670	+5	580	+5	1000	-3	1100
Ni	-100	0.06	-100	0.23	-100	0.05	-100	0.15
Sr	+114	7.9	+121	1.1	145	2.24	+173	2.7
Th	-95	0.17	-98	-0.12	-100	~0	-98	0.34
Zn	-100	0.05	-98	0.08	-99	0.06	-98	0.10

Table A.8. 1981 titration data obtained from sample from the southeast acid pond at the Y-12 Plant

(using 1.N NaOH in 100-mL samples)

October 7—top sample				October 14—bottom sample				October 22—top sample			
(mL)	(pH)	(mL)	(pH)	(mL)	(pH)	(mL)	(pH)	(mL)	(pH)	(mL)	(pH)
0	1.9	18	4.2	0	1.9	18	3.9	0	1.6	18	4.1
0.5	2.2	19	4.2	1	2.1	19	4.0	1	1.7	19	4.1
1.0	2.3	20	4.2	2	2.6	20	4.0	2	2.0	20	4.1
1.5	2.8	21	4.3	3	3.1	21	4.0	3	2.5	21	4.2
2.0	3.1	22	4.3	4	3.3	22	4.0	4	3.2	22	4.2
2.5	3.4	23	4.4	5	3.5	23	4.1	5	3.5	23	4.3
3.0	3.5	24	4.5	6	3.5	24	4.1	6	3.6	24	4.3
3.5	3.6	25	4.5	7	3.6	25	4.1	7	3.7	25	4.4
4.0	3.7	26	4.6	8	3.7	26	4.2	8	3.8	26	4.5
5.0	3.8	27	4.8	9	3.7	27	4.2	9	3.8	27	4.7
6.0	3.8	28	5.3	10	3.7	28	4.3	10	3.8	28	5.0
7.0	3.9	29	6.4	11	3.8	29	4.3	11	3.9	29	5.4
8.0	3.9	30	6.9	12	3.8	30	4.5	12	3.9	30	6.1
9.5	4.0	31	7.4	13	3.8	31	4.6	13	3.9	31	6.8
10	4.0	32	7.7	14	3.9	32	5.2	14	4.0	32	7.2
11	4.0	33	8.1	15	3.9	33	5.9	15	4.0	33	7.6
12	4.0	34	8.4	16	3.9	34	6.5	16	4.0		
13	4.1	35	8.6	17	3.9	35	7.0	17	4.0		
14	4.1	36	8.8			36	7.4				
15	4.1	37	8.9			37	7.8				
16	4.1	38	9.0			38	8.1				
17	4.1										

Table A.9 1981 Titration data obtained from smple from the Northeast acid pond at the Y-12 Plant [using 1.0 *N* NaOH in 200 mL (top samples) and 50 mL (bottom)].

October 7—top sample		October 14—bottom sample				October 22—top sample	
(mL)	(pH)	(mL)	(pH)	(mL)	(pH)	(mL)	(pH)
0	2.1	0	1.3	18	3.8	0	2.1
2	2.3	1	1.3	19	3.8	1	2.1
4	2.8	2	1.3	20	3.9	2	2.3
5	3.4	3	1.3	21	3.9	3	2.5
5.5	3.9	4	1.3	22	3.9	4	3.2
6	4.1	5	1.4	23	4.0	5	3.9
6.5	4.2	6	1.4	24	4.1	6	4.1
7	4.2	7	1.5	25	4.1	7	4.1
8	4.3	8	1.5	26	4.2	8	4.2
9	4.3	9	1.6	27	4.2	9	4.3
10	4.4	0	1.7	28	4.6	10	4.5
11	4.5	11	1.8	29	5.1	11	4.9
12	4.7	12	2.0	30	5.9	12	5.7
12.5	4.8	13	2.5	31	6.8	13	6.7
13	5.0	14	3.1	32	7.6	14	8.3
13.5	5.3	15	3.5	33	8.2		
14	5.8	16	3.6				
14.5	6.7	17	3.7				
15	7.2						
15.5	7.7						
16	8.2						
16.5	8.6						
17	9.0						

Table A.10 1981 Titration data obtained from sample from the Southwest acid pond at the Y-12 Plant, [using 1.0 *N* NaOH in 100 mL (October 7 and 14 samples), 100 mL (October 22 sample)]

October 7—top sample		October 14—bottom sample		October 22—top sample			
(mL)	(pH)	(mL)	(pH)	(mL)	(pH)	(mL)	(pH)
0	1.8	0	1.6	0	1.6	18	3.9
1	1.9	1	1.7	1	1.7	19	4.0
2	2.0	2	1.7	2	1.7	20	4.0
3	2.1	3	1.8	3	1.8	21	4.0
4	2.3	4	2.0	4	1.8	22	4.1
5	2.7	5	2.6	5	1.9	23	4.1
6	3.6	6	3.4	6	2.0	24	4.1
7	3.9	7	3.7	7	2.1	25	4.2
8	4.1	8	3.8	8	2.2	26	4.2
9	4.1	9	3.9	9	2.5	27	4.3
10	4.2	10	4.0	10	2.8	28	4.3
11	4.2	11	4.0	11	3.3	29	4.4
12	4.3	12	4.1	12	3.6	30	4.6
13	4.4	13	4.2	13	3.7	31	4.9
14	4.5	14	4.3	14	3.8	32	5.3
15	4.8	15	4.5	15	3.9	33	5.9
16	5.5	16	5.1	16	3.9	34	6.6
17	6.7	17	6.6	17	3.9	35	7.2
18	8.0	18	7.7			36	7.8
19	9.0	19	8.6				

Table A.11. 1981 Titration data obtained from sample from the Northwest acid pond at the Y-12 Plant, [using 1.0 *N* NaOH in 100 mL (October 7 sample), 50 mL (October 14 sample), and 200 mL (October 22 sample)]

October 7—top sample				October 14—bottom sample				October 22—top sample			
(mL)	(pH)	(mL)	(pH)	(mL)	(pH)	(mL)	(pH)	(mL)	(pH)	(mL)	(pH)
0	1.7	18	4.5	0	0.9	18	3.6	0	1.5	18	3.4
1	1.7	19	4.7	1	1.1	19	3.7	1	1.5	19	3.6
2	1.8	20	5.3	2	1.1	20	3.7	2	1.6	20	3.8
3	1.8	21	6.4	3	1.2	21	3.7	3	1.6	21	3.8
4	1.9	22	7.7	4	1.2	22	3.8	4	1.6	22	3.9
5	2.0	22.5	8.3	5	1.3	23	3.8	5	1.6	23	3.9
6	2.1	23	8.7	6	1.5	24	3.8	6	1.7	24	3.9
7	2.3	23.5	9.1	7	1.7	25	3.9	7	1.7	25	4.0
8	2.6			8	2.1	26	3.9	8	1.7	26	4.0
9	3.4			9	2.6	27	4.0	9	1.8	27	4.0
10	3.9			10	2.9	28	4.1	0	1.8	28	4.0
11	4.0			11	3.2	29	4.2	1	1.9	29	4.1
12	4.1			12	3.4	30	4.3	2	1.9	30	4.1
13	4.1			13	3.4	31	4.6	3	2.0	31	4.2
14	4.2			14	3.5	32	5.2	4	2.1	32	4.2
15	4.2			15	3.5	33	6.1	5	2.3	33	4.3
16	4.3			16	3.6	34	6.9	6	2.5	34	4.3
17	4.4			17	3.6	35	7.6	7	2.8	35	4.4
						36	8.1			36	4.6
										37	4.8
										38	5.2
										39	5.7
										40	6.3
										41	7.0
										42	7.8

Table 12. Neutralization of four S-3 acid ponds at Y-12 Plant with biodenitrification sludge data (sludge pH 7.6)

Pond	Neutralization data
Southeast	250 mL of sludge was required to neutralize 50-mL sample. This amount attained the maximum pH of 6.6; 2.3 g CaO was added to the sample to reach a pH of 8.1
Northeast	50 mL of sludgee was required to neutralize 25-mL sample. This amount attained the maximum pH of 7.3; 0.1 g CaO was added to the sample to reach a pH of 8.2
Southwest	Test was not performed on this pond
Northwest	125 mL of sludge was required to neutralize 25-mL sample. This amount attained the maximum pH of 6.9; 0.4 g CaO was added to the sample to reach a pH of 9.2

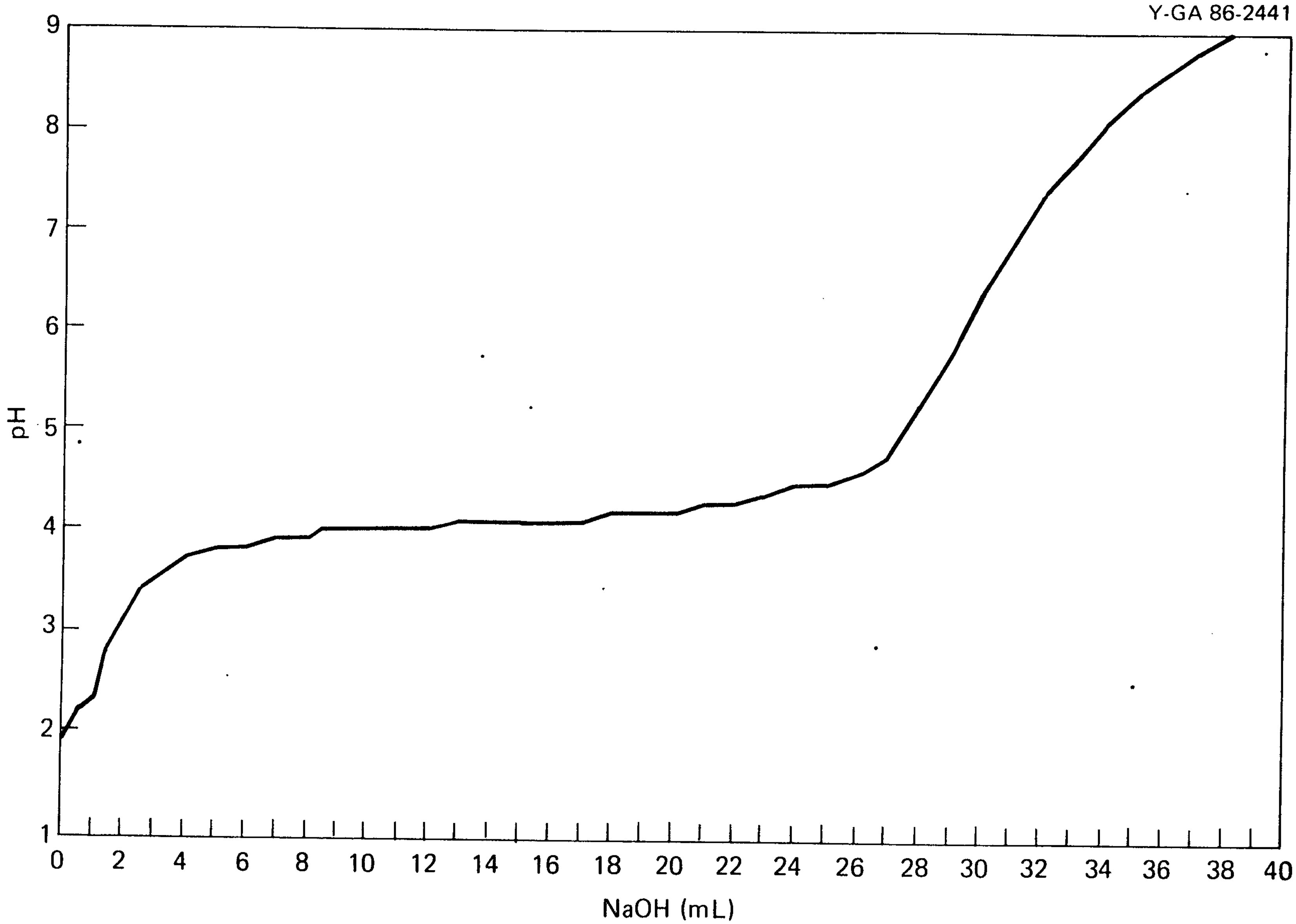

Fig. 1. SOUTHEAST POND AT Y-12 PLANT: PLOT OF TITRATION DATA.

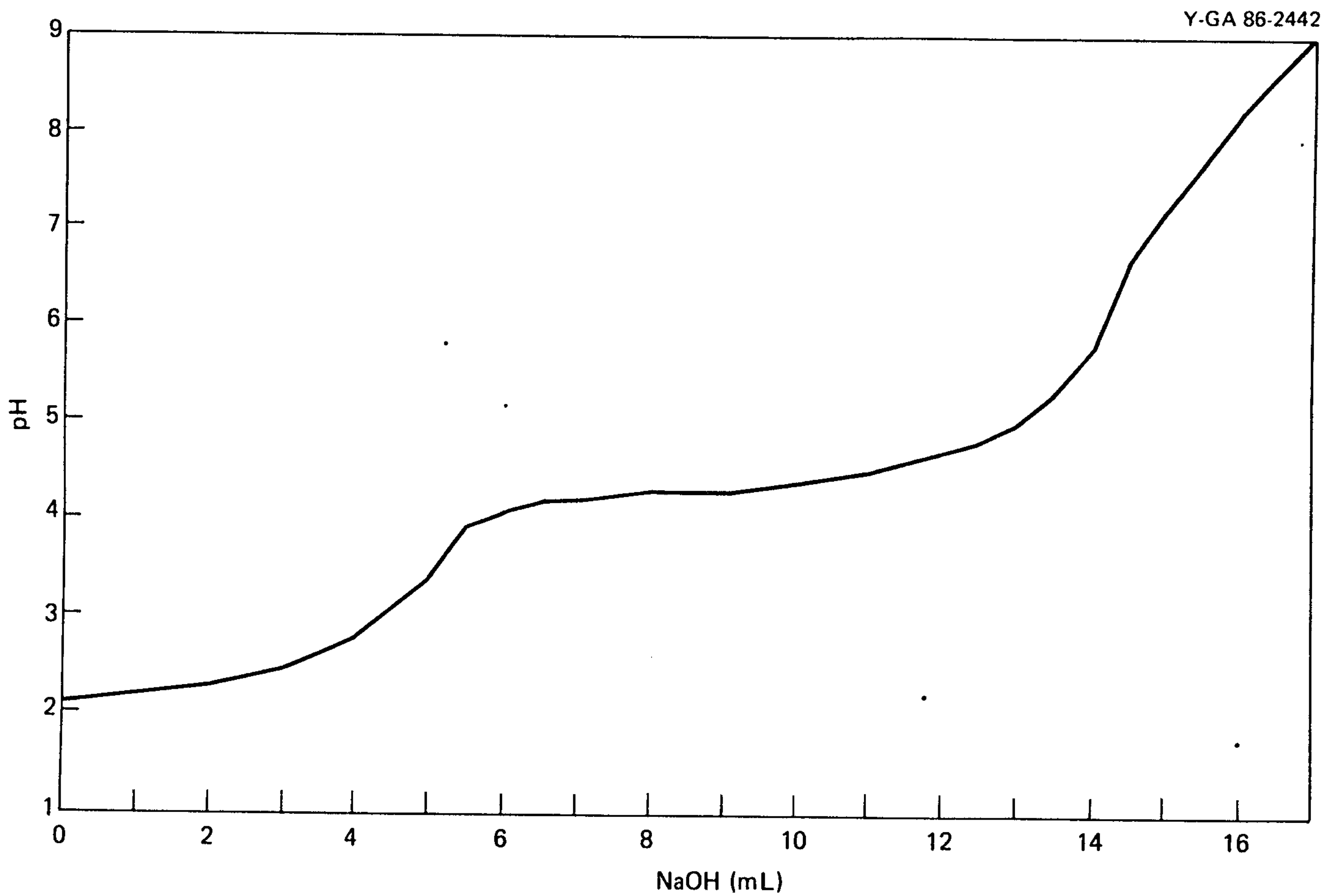

Fig. 2. NORTHEAST POND AT Y-12 PLANT: PLOT OF TITRATION DATA.

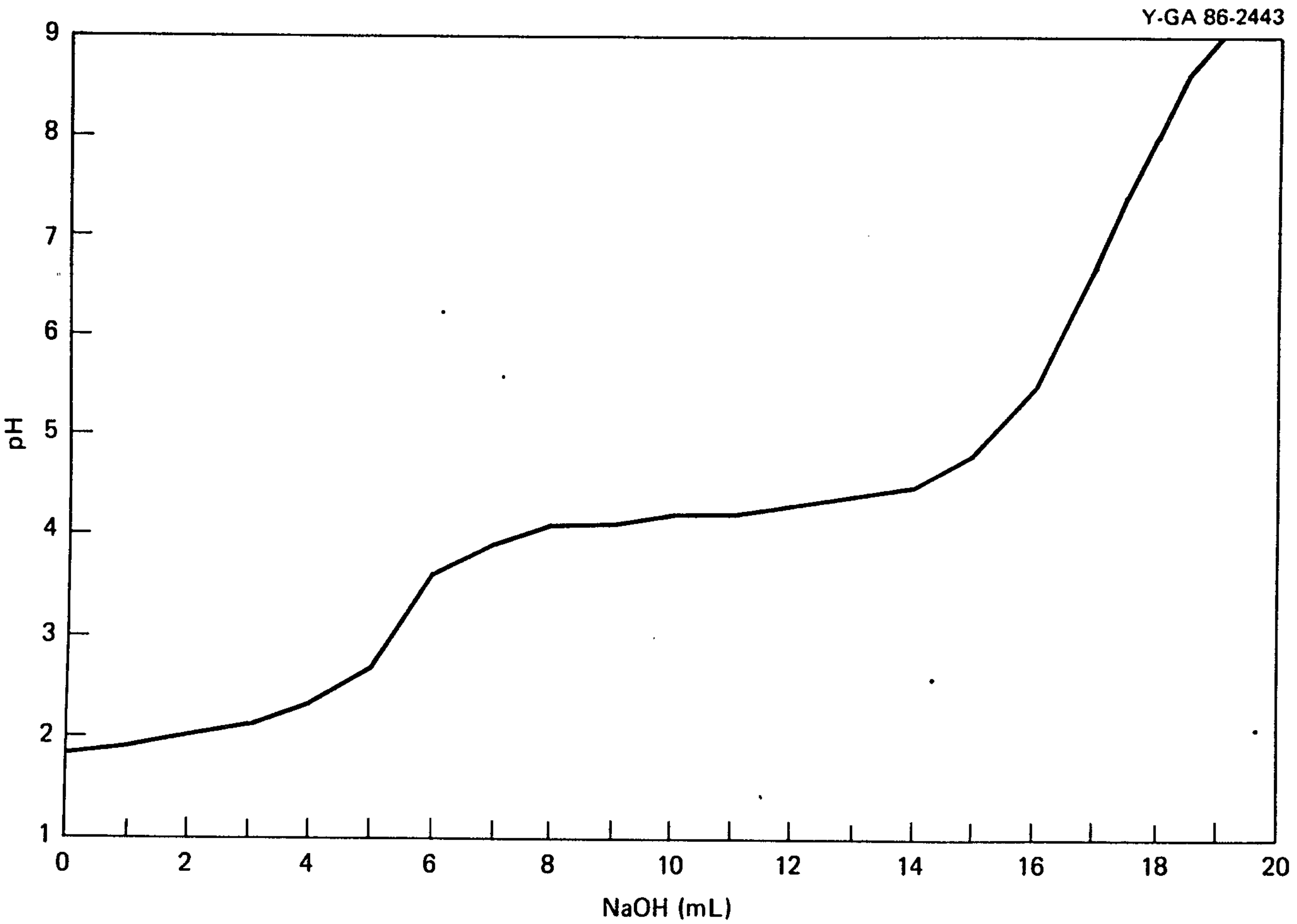

Fig. 3. SOUTHWEST POND AT Y-12 PLANT: PLOT OF TITRATION DATA.

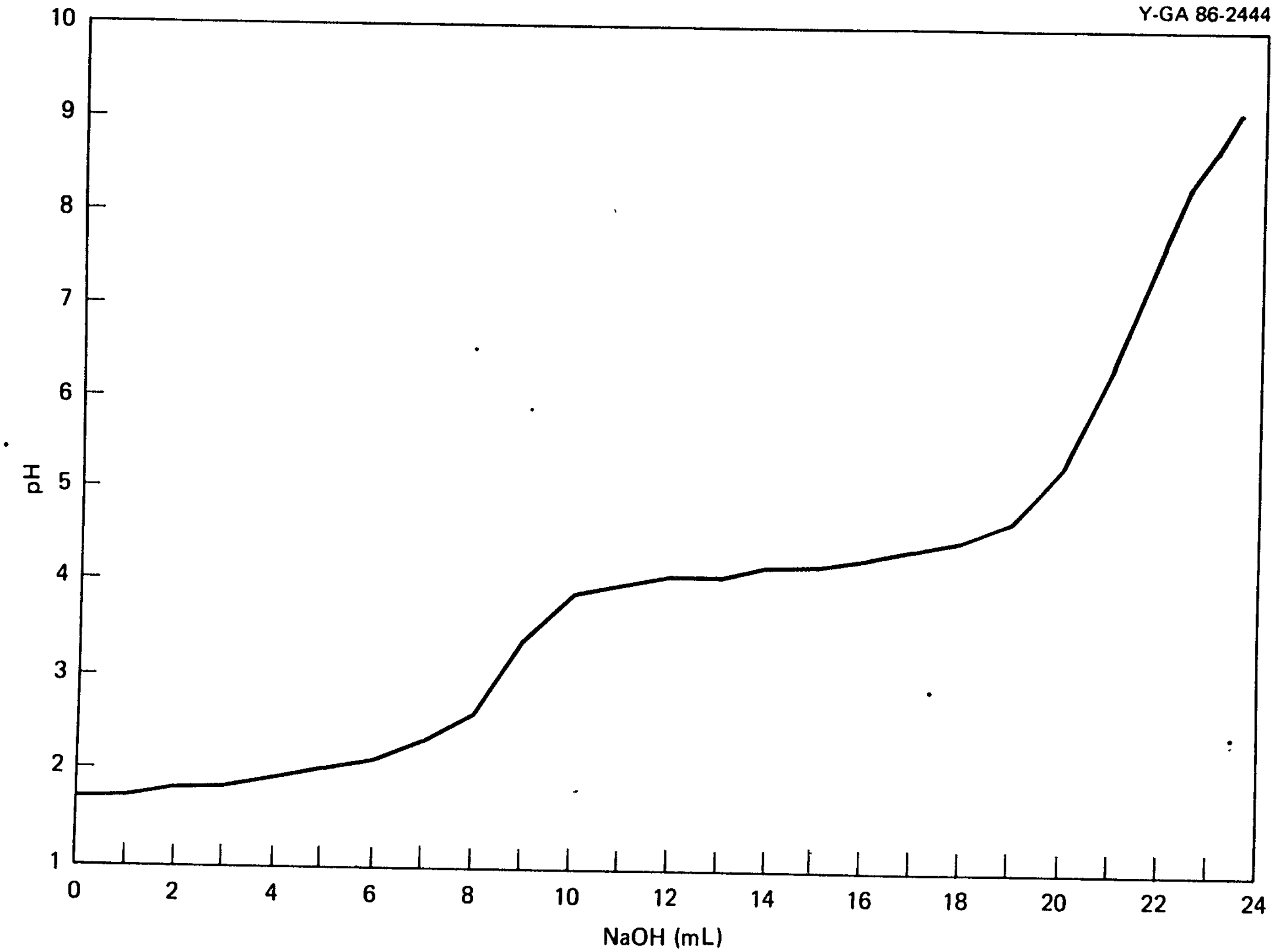

Fig. 4. NORTHWEST POND AT Y-12 PLANT: PLOT OF TITRATION DATA.

Y-GA 86-2445

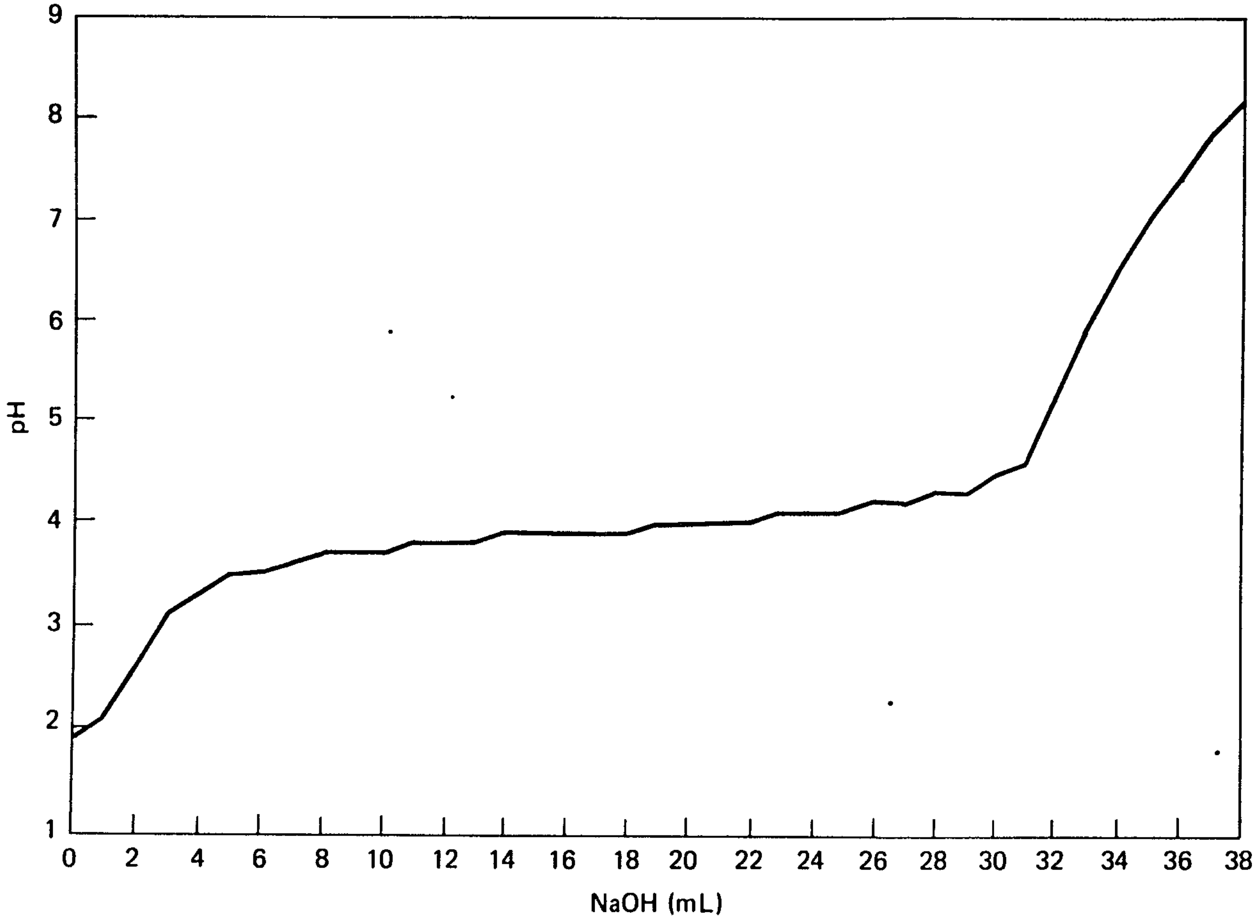

Fig. 5. SOUTHEAST POND — BOTTOM LAYER AT Y-12 PLANT: PLOT OF TITRATION DATA.

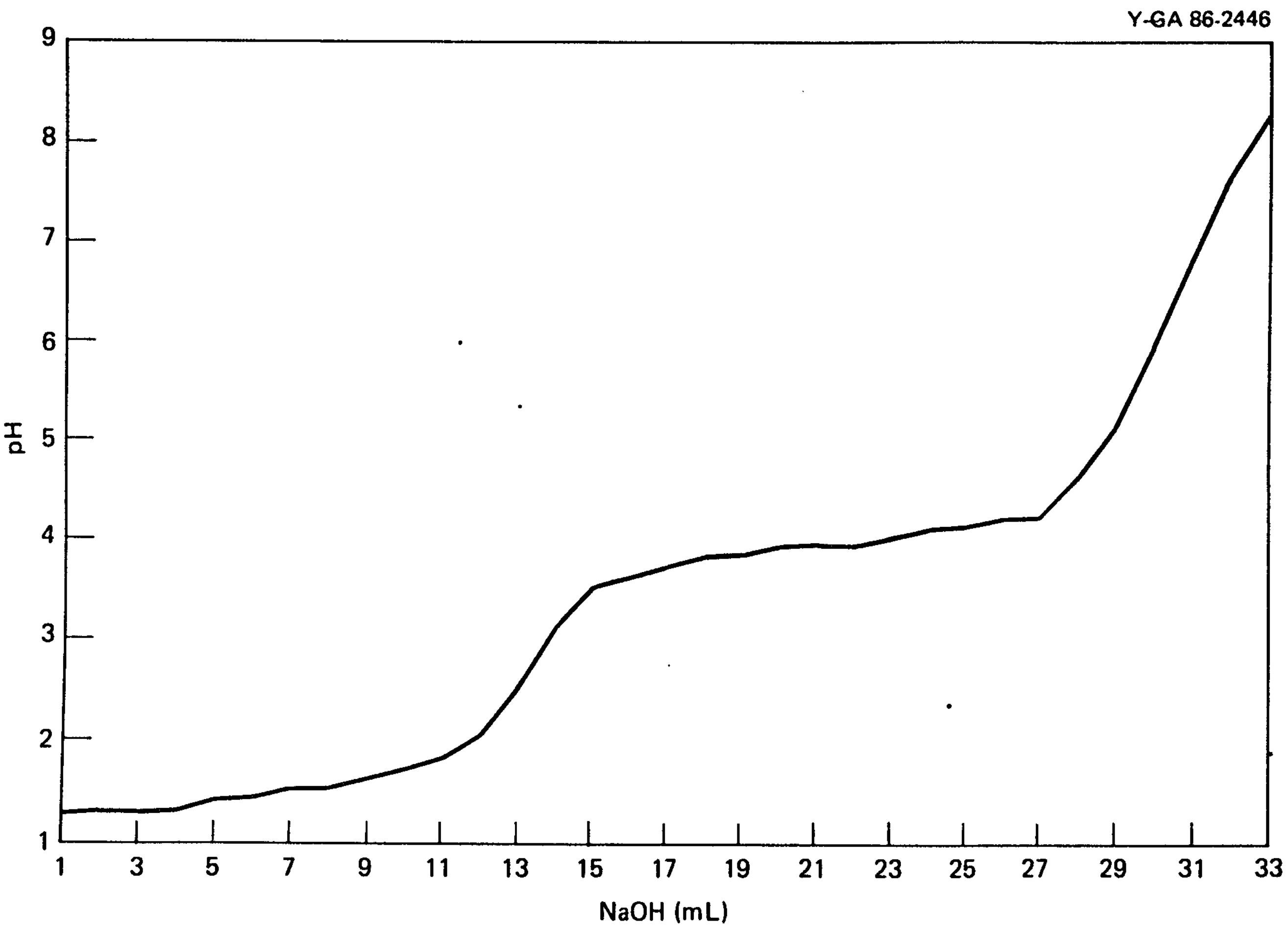

Fig. 6. NORTHEAST POND — BOTTOM LAYER AT Y-12 PLANT: PLOT OF TITRATION DATA.

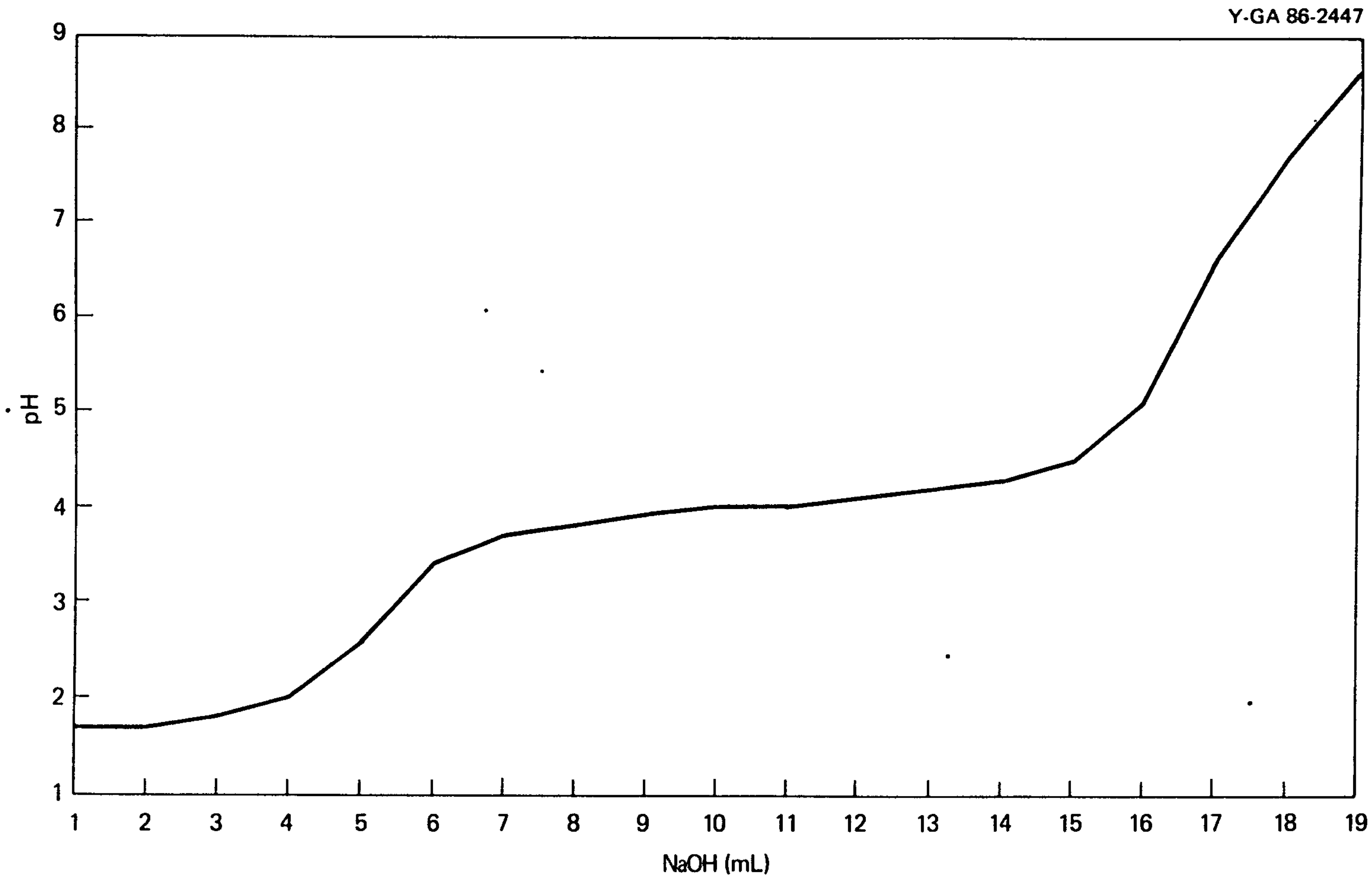

Fig. 7. SOUTHWEST POND — BOTTOM LAYER AT Y-12 PLANT: PLOT OF TITRATION DATA.

Y-GA 86-2448

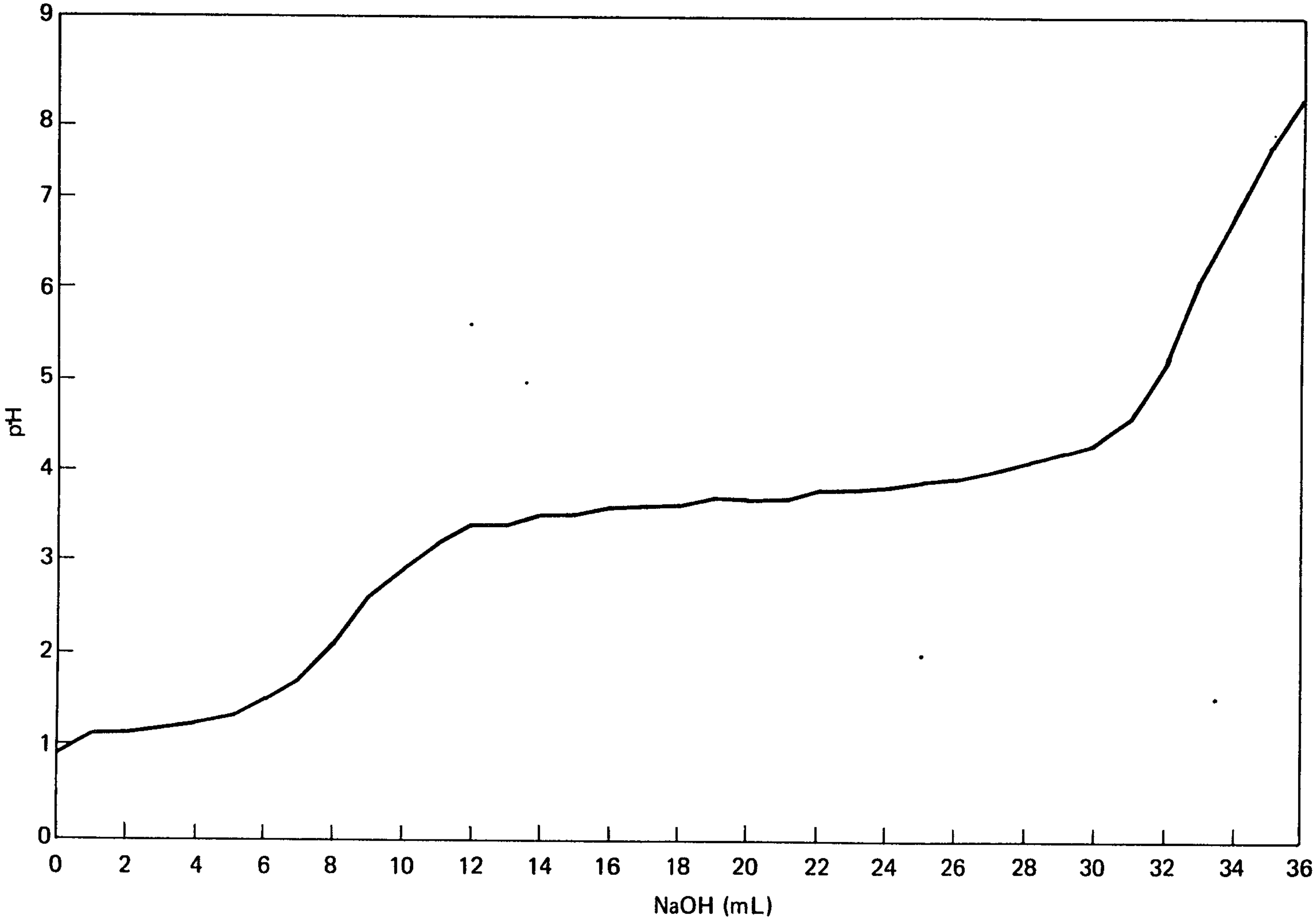

Fig. 8. NORTHWEST POND — BOTTOM LAYER AT Y-12 PLANT: PLOT OF TITRATION DATA.

Fig. A.1. Southeast pond at Y-12 Plant: plot of titration data.

Fig. A.2. Northeast pond at Y-12 Plant: plot of titration data.

Fig. A.3. Southwest pond at Y-12 Plant: plot of titration data.

Fig. A.4. Northwest pond at Y-12 Plant: plot of titration data.

Fig. A.5. Southeast pond—bottom layer at Y-12 Plant: plot of titration data.

Fig. A.6. Northeast pond—bottom layer at Y-12 Plant: plot of titration data.

Fig. A.7. Southwest pond—bottom layer at Y-12 Plant: plot of titration data.

Fig. A.8. Northwest pond—bottom layer at Y-12 Plant: plot of titration data.

Distribution of Rev. 1

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